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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the transfer method of a metal membrane, and the manufacturing method of a laminated ceramic electronic component.

[0002]

[Description of the Prior Art]In recent years, from the miniaturization of electronic equipment, or a viewpoint of saving resources, in the miniaturization of a laminated ceramic electronic component, especially the laminated ceramic capacitor, large scale-ization by lamination and multilayering is progressing quickly, and what has a defect in which it is more thinly uniform also about an internal electrode, and few is needed.

[0003]The formation method of the internal electrode of a laminated ceramic electronic component has the common method of printing the metal paste which consists of metal powder and an organic binder to a ceramic green sheet by screen-stencil.

[0004]However, in the conventional screen printing, from lamination having a limit with the grain size of raw material metal particles, or the thickness of a screen, and an electrode being formed by sintering of particles, there is a problem that an electrode becomes discontinuous easily, so that lamination is carried out.

[0005]Then, the manufacturing method of the laminated ceramic electronic component which constitutes an internal electrode using the metal membrane formed by various thin-film-forming methods is proposed.

[0006]For example, the manufacturing method proposed by JP,7-54780,B, JP,4-314876,A, JP,8-115847,A, JP,5-74651,A, etc., The metal membrane produced with the combination of vacuum-film-formation-method independence or vacuum film formation method, and wet plating on the carrier film which consists of the synthetic resin or metal which performed exfoliation processing of a silicone coat etc. is transferred to a ceramic green sheet by thermo

compression bonding.

[0007]The manufacturing method proposed by JP,6-231999,A, JP,10-125556,A, and JP,10-208980,A, The metal membrane produced by the electroless deposition method on the carrier film which consists of synthetic resins is transferred to a ceramic green sheet by thermo compression bonding or a hot printing method.

[0008]Namely, it is directly said to a ceramic green sheet that the manufacturing method of the laminated ceramic electronic component proposed from the former transfers the metal membrane formed by various thin-film-forming methods on the carrier film.

[0009]

[Problem(s) to be Solved by the Invention]However, it is difficult to transfer the pure metal film which does not almost have an adhesive property generally that there is little content of an organic binder and there is no defect on the ceramic green sheet which breaks easily. For this reason, in the manufacturing method of the conventional laminated ceramic electronic component, in general, the application of pressure more than heating and $20\text{kg}/\text{cm}^2$ of not less than 50°C was needed, and restrictions are followed on the transfer condition. In this case, in order to heat to a predetermined temperature and to pressurize a predetermined pressure, since fixed time was needed, productivity was low, and needed the pressing machine which generates the high voltage provided with the heating method, and there was a problem that facility cost became high.

[0010]In the manufacturing method of the conventional laminated ceramic electronic component. Since the direct transfer method which pushes directly the carrier film in which the metal membrane was formed in the surface of the ceramic green sheet which breaks easily, and transfers a metal membrane is adopted, the technical problem that the portion equivalent to the circumference of metallic film patterns on a ceramic green sheet is easy to be destroyed occurs. This will be considered because the pressure put at the time of transfer is unabsorbable, if 5 micrometers of thickness of the ceramic green sheet which is a transferred member become as follows very thin, for example and cushion effect becomes small.

[0011]The 1st purpose of this invention solves the problem of such conventional technology, and the pattern of a very thin and uniform metal membrane, It is in providing the transfer method of the metal membrane which could transfer very easily and certainly on the surface of the transferred member on which a green sheet etc. break easily, and fitted especially automation of the transfer line on it.

[0012]The 2nd purpose of this invention is very easy and to provide the manufacturing method of the laminated ceramic electronic component which could manufacture by low cost and fitted especially automation of the production line about the laminated ceramic electronic component for which thickness has an internal electrode which is thinly uniform and has few defects.

[0013]

[Means for Solving the Problem](1) In order to attain the 1st purpose of the above, a transfer method of a metal membrane concerning this invention is provided with the following.

The 1st contact process to which the 1st glue line side of a member for metal membrane transfer by which a metal membrane is formed with a prescribed pattern on the surface of a base, and the 1st glue line is formed in the surface of said metal membrane is contacted on the surface of a porous intermediate medium.

The 1st transfer process that pulls apart said base from said porous intermediate medium, and transfers a metal membrane of a prescribed pattern via said 1st glue line on the surface of said porous intermediate medium.

The 2nd contact process that contacts the metal membrane side of a porous intermediate medium with which a metal membrane of said prescribed pattern was transferred to a transferred member.

A process of weakening adhesive strength of said 1st glue line, and the 2nd transfer process that pulls apart said porous intermediate medium from said transferred member, and transfers a metal membrane of a prescribed pattern on the surface of said transferred member.

[0014](2) In order to attain the 2nd purpose of the above, a manufacturing method of a laminated ceramic electronic component concerning this invention is provided with the following.

The 1st contact process to which the 1st glue line side of a member for metal membrane transfer by which a metal membrane is formed with a prescribed pattern on the surface of a base, and the 1st glue line is formed in the surface of said metal membrane is contacted on the surface of a porous intermediate medium.

The 1st transfer process that pulls apart said base from said porous intermediate medium, and transfers a metal membrane of a prescribed pattern via said 1st glue line on the surface of said porous intermediate medium.

The 2nd contact process that contacts the metal membrane side of a porous intermediate medium with which a metal membrane of said prescribed pattern was transferred to a green sheet.

A process of weakening adhesive strength of said 1st glue line, and the 2nd transfer process that pulls apart said porous intermediate medium from said green sheet, and transfers a metal membrane of a prescribed pattern on the surface of said green sheet, A laminating process which laminates a green sheet in which a metal membrane of said prescribed pattern was transferred with other green sheets, and a baking process which calcinates a laminated green sheet.

[0015]It is preferred to have a cutting process which makes a laminated green sheet cut before

said baking process.

[0016](3) An order in particular of said 2nd contact process and a process of weakening adhesive strength of said 1st glue line is not limited. That is, after contacting the metal membrane side of said porous intermediate medium on the surface of transferred members, such as a green sheet, it is good also as weakening adhesive strength of the 1st glue line formed in said porous intermediate medium. After weakening adhesive strength of the 1st glue line formed in said porous intermediate medium, the metal membrane side of said porous intermediate medium may be contacted on the surface of transferred members, such as a green sheet. After weakening adhesive strength of the 1st glue line in the case of the latter, in order to prevent a metal membrane from moving from the surface of a porous intermediate medium by the time it makes the surface of a transferred member contact, it is preferred to hold a metal membrane on the surface of a porous intermediate medium by holding mechanism of a vacuum sucking device etc.

[0017]In order to weaken adhesive strength of said 1st glue line, it is preferred to supply a drug solution which can dissolve said 1st glue line to said 1st glue line.

[0018]A drug solution for the dissolution used in this invention is suitably determined by a relation with resin which constitutes said 1st glue line. For example, when resin which constitutes the 1st glue line is an acrylic ester system, organic solvents of a drug solution, such as methanol, ethanol, ethylene glycol, or glycerin, are preferred. When resin which constitutes a glue line is anionic form electrodeposition resin, in the case of cation form electrodeposition resin, aqueous acids of a basic aqueous solution are preferred respectively. When a drug solution is acidity or a basic aqueous solution, it is preferred to, choose volatile solutes, such as acetic acid, ammonia, ammonium carbonate, or ethanolamine, for example.

[0019](4) It is preferred to have the process of forming the 2nd glue line in the surface of a metal membrane of a prescribed pattern transferred by said porous intermediate medium, before said 2nd contact process.

[0020]As for said 2nd glue line, it is preferred to be constituted including a plasticizer added [a selected organic binder and if needed] so that it may not dissolve in said drug solution which dissolves the 1st glue line of a member for metal membrane transfer. For example, when a drug solution which dissolves the 1st glue line is an aqueous solution system, as an organic binder, it is usable in phthalic ester as plasticizers, such as an acrylic resin and ethyl cellulose. When said drug solution is an organic solvent system, as an organic binder besides combination of an acrylic resin which does not dissolve in said drug solution, and a plasticizer, it is usable in ethanolamine etc. as polyvinyl alcohol and a plasticizer.

[0021]Said 2nd glue line is thin to a metal membrane and an equivalent grade, and its uniform thing is preferred. 0.1-10 micrometers of concrete thickness are 0.1-1.0 micrometer still more preferably preferably.

[0022]A formation method in particular of said 2nd glue line is not limited, but into a resin solution which constitutes the 2nd glue line, a metal membrane of said prescribed pattern may immerse a porous intermediate medium transferred via the 1st glue line, and it may form it by drying. It is good also as a metal membrane of said prescribed pattern carrying out coating or spraying, and forming a resin solution which constitutes the 2nd glue line in the metal membrane side side of a porous intermediate medium transferred via the 1st glue line. Anyway, a resin solution which exists on the surface of a porous intermediate medium is absorbed in a medium, and the 2nd glue line is formed only in the surface of a metal membrane of a prescribed pattern.

[0023](5) As a porous intermediate medium used for this invention, What has the porosity and moderate pliability of a grade which can absorb a resin solution which constitutes said 2nd glue line, and high intensity is preferred, for example, can mention nonwoven fabrics, such as papers, such as a filter paper and Kent paper, polyethylene, polyester, polypropylene, cuprammonium rayon, or a product made from rayon, etc. Especially, a nonwoven fabric made of a synthetic resin with little elasticity by water is preferred.

[0024](6) As for the 1st glue line of a member for metal membrane transfer used for this invention, being constituted including a thermoplastic organic high polymer is preferred.

[0025]It is preferred that a thermoplastic organic high polymer contained in said 1st glue line is acrylic resin or acrylic copolymerization system resin.

[0026]Thickness of said 1st glue line should just be the thickness of a grade which can be pasted up on a porous intermediate medium, and although it is not limited in particular, it is 0.1-1 micrometer still more preferably 0.1-10 micrometers preferably. Although thickness of a metal membrane is not limited in particular, either, 0.1-30 micrometers is 0.1-1.5 micrometers still more preferably preferably.

[0027]A formation method in particular of said 1st glue line is not limited, for example, can mention methods, such as electropainting, a spray painting method, print processes. However, it is preferred to form with electropainting from a viewpoint which can be formed only in the metal membrane surface.

[0028](7) Said base of a member for metal membrane transfer used for this invention is conductivity, for example. It is a set of an isolated pattern which was not limited, for example, was mutually separated on the surface of said base especially as a pattern of a metal membrane formed in the surface of said base. As for said metal membrane, it is preferred that it is the metal membrane formed by an electrolytic plating method.

[0029]Said base may be insulation. When forming the 1st glue line by electropainting, a pattern of a metal membrane formed in the surface of said base is a pattern which stands in a row on the surface of said base. As for a pattern of a metal membrane formed in the surface of said base, it is preferred that it is a pattern which has a pad section used as an electrode for voltage

impressing at the time of electropainting in this case.

[0030]In this invention, although concrete shape in particular of a base is not limited, it is preferred that it is a sheet shaped. A smooth thing of the surface of a base is preferred.

[0031](8) A member for metal membrane transfer used for this invention can be manufactured with a manufacturing method which has a process of forming a metal membrane with a prescribed pattern on the surface of a base, and the process of forming in the surface of said metal membrane a glue line which contains a thermoplastic organic high polymer with electropainting, for example.

[0032]It is preferred to form in the surface of the base concerned a metal membrane patternized by an electrolytic plating method, using a conductive base as said base, and to form said 1st glue line with electropainting only on the metal membrane especially.

[0033]

[Function]In the transfer method of the metal membrane concerning this invention, it differs from the conventional method which was transferring the metal membrane from the member for metal membrane transfer to the transferred member directly, The metal membrane is transferred to the intermediate media which once have high intensity, such as paper, and the surface of transferred members, such as a ceramic green sheet, is made to transfer a metal membrane using this.

[0034]When transferring a metal membrane to intermediate media, there are few possibilities that intermediate media may break, control of the temperature for transfer or a pressure is easy for them, and more perfect transfer is possible for them. Without almost applying a pressure to a transferred member, since it transfers after weakening the adhesive strength of intermediate media and a metal membrane when transferring from intermediate media to transferred members, such as a ceramic green sheet, good transfer is possible and there is almost no possibility that a transferred member may break.

[0035]Since it has used transferring the metal membrane to intermediate media with high intensity, and making a transferred member transfer a metal membrane using this according to the transfer method of the metal membrane concerning such this invention, Even when forming a metal membrane in transferred members, such as a ceramic green sheet which breaks easily, it can transfer with ordinary temperature and low pressure, and the pattern of a very thin and uniform metal membrane can be transferred very easily and certainly. There are few especially possibilities that a transferred member breaks easily like a ceramic green sheet, and the circumference of the metallic film patterns of a transferred member may moreover be destroyed since it can transfer with ordinary temperature and low pressure even if as follows very thin 5 micrometers.

[0036]That is, since according to the transfer method of the metal membrane concerning this invention it is hard to produce destruction of the surrounding portion of a metal membrane

even if it transfers a metal membrane to the transferred member which breaks easily, improvement in the yield can be expected and automation of a metal membrane transfer line becomes easy.

[0037]In the manufacturing method of the laminated ceramic electronic component concerning this invention, since the transfer method of the above-mentioned metal membrane is used, while being able to manufacture the laminated ceramic electronic component in which thickness has an internal electrode which is thinly uniform and has few defects by very easy and low cost, automation of a production line becomes easy.

[0038]Especially as a laminated ceramic electronic component, although not limited, a laminated ceramic capacitor, a piezoelectric element, a chip inductor, a chip varistor, a chip thermistor, a chip resistor, and other surface mount (SMD) chip type electronic components are illustrated.

[0039]

[Embodiment of the Invention]Hereafter, this invention is explained based on the embodiment shown in a drawing. The partial fracture sectional view of the laminated ceramic capacitor which requires drawing 1 for one embodiment of this invention, The perspective view of the green sheet used for the manufacturing process of the capacitor which shows drawing 2 in the top view of a laminated ceramic capacitor, and shows drawing 1 and drawing 2 drawing 3, The sectional view which meets the V-V line which shows drawing 4 in the perspective view of the member for metal membrane transfer, and shows drawing 4 drawing 5, and drawing 6 are process drawings showing an example of the transfer method of the metal membrane to a green sheet.

[0040]By this embodiment, the laminated ceramic capacitor 2 shown in drawing 1 and drawing 2 is illustrated as a laminated ceramic electronic component, and the structure and manufacturing method are explained.

[0041]The structure of laminated ceramic capacitor **** and a laminated ceramic capacitor is explained. As shown in drawing 1 and drawing 2, the laminated ceramic capacitor 2 concerning this embodiment has the capacitor element pack 4, the 1st terminal electrode 6, and the 2nd terminal electrode 8. The capacitor element pack 4 has the dielectric layer 10, the 1st internal electrode layer 12, and the 2nd internal electrode layer 14, and has the multilayer structure which has laminated the 1st internal electrode layer 12 and the 2nd internal electrode layer 14 by turns between the dielectric layers 10. The end of each 1st internal electrode layer 12 is electrically connected to the inside of the 1st terminal electrode 6 currently formed in the outside of the 1st end 4a of the capacitor element pack 4. The end of each 2nd internal electrode layer 14 is electrically connected to the inside of the 2nd terminal electrode 8 currently formed in the outside of the 2nd end 4b of the capacitor element pack 4.

[0042]Although the internal electrode layers 12 and 14 transfer the metal membrane 22 (refer

to drawing 4) mentioned later to a dielectric green sheet, and are formed and it is constituted from this embodiment by the same construction material as the metal membrane 22, the thickness becomes thicker than the metal membrane 22 by the horizontal contraction by calcination.

[0043]The construction material in particular of the dielectric layer 10 is not limited, for example, comprises dielectric materials, such as titanate, calcium titanate, strontium titanate, and/or barium titanate. Although the thickness in particular of each dielectric layer 10 is not limited, its thickness (several micrometers - hundreds of micrometers) is common.

[0044]Although the construction material in particular of the terminal electrodes 6 and 8 is not limited, either, although copper, a copper alloy, nickel, a nickel alloy, etc. are used, silver, silver, the alloy of palladium, etc. can usually be used. Although the thickness in particular of the terminal electrodes 6 and 8 is not limited, either, it is usually about 10-50 micrometers.

[0045]What is necessary is just to determine suitably the shape and size of such a laminate type ceramic capacitor 2 according to the purpose or a use. When the laminated ceramic capacitor 2 is rectangular parallelepiped shape, it is usually about 0.6-3.2mmx0.3-1.6mmx0.1-1.2mm.

[0046]The manufacturing method following ** of a laminated ceramic capacitor explains the manufacturing method of the above-mentioned laminated ceramic capacitor 2. First, the paste for dielectric layers is prepared. The paste for dielectric layers comprises an organic solvent system paste produced by kneading a dielectric raw material and an organic vehicle, or a water soluble solvent system paste. As a dielectric raw material, it is suitably chosen from the various compounds used as a multiple oxide or an oxide, for example, carbonate, a nitrate, hydroxide, an organic metallic compound, etc., and can mix and use.

[0047]With an organic vehicle, a binder is dissolved into an organic solvent, and it is not limited especially as a binder used for an organic vehicle, but the various usual binders, such as ethyl cellulose, a polyvinyl butyral, and an acrylic resin, are used. An organic solvent in particular is not limited, either but organic solvents, such as a terpineol, butylcarbitol, acetone, and toluene, are used.

[0048]As a water soluble solvent used for a water soluble solvent system paste, the solvent in which water was made to dissolve a water soluble binder, a dispersing agent, etc. is used. It is not limited especially as an aqueous system binder, but polyvinyl alcohol, methyl cellulose, hydroxyethyl cellulose, water soluble acrylic resin, an emulsion, etc. are used.

[0049]What is necessary is not to limit the content in particular of the organic vehicle of each paste mentioned above, but to make the usual content, for example, a binder, into about 1 to 5 % of the weight, and just to make a solvent into about 10 to 50 % of the weight. During each paste, the additive chosen from various dispersing agents, a plasticizer, glass frit, an insulator, etc. if needed may contain.

[0050]The green sheet 10a shown in drawing 3 is formed with a doctor blade method etc. using such a paste for dielectric layers.

[0051]Next, the pattern 12a of the metal membrane used as the internal electrode 12 shown in drawing 1 is formed in the surface of the green sheet 10a with a replica method. The pattern 14a of the metal membrane used as the internal electrode 14 shown in drawing 1 is formed in the surface of another green sheet 10a with a replica method.

[0052]The patterns 12a and 14a of a metal membrane can be formed in the surface of the green sheet 10a with the same replica method. The following explanation explains how to form the pattern 12a of an electrode in the surface of the green sheet 10a with a replica method.

[0053]First, as shown in drawing 5, the metal membrane 22 and the 1st glue line 24 which were patternized are formed in the surface of the sheet-shaped base 20.

[0054]The base 20 Conductive bases, such as a metal plate and a metallic foil, polyethylene terephthalate, Although any of insulating bases, such as polypropylene, or the compound base which formed or laminated the conductive thin film on the surface of the insulating base so that it might not exfoliate substantially may be sufficient, in this embodiment, the conductive base is adopted and pre-insulation of the back has been carried out. As compared with the thickness of the metal membrane to form, the sufficiently small thing of the surface roughness of the base 20 is desirable.

[0055]As a means to form the patternized metal membrane 22, Via the mask which is not limited, for example, has an opening of desired pattern shape beforehand especially, with vacuum film formation method, such as vacuum evaporation and sputtering. The metal membrane 22 is formed in the surface of the base 20, and the method of growing up the metal membrane 22 to desired thickness by the wet producing-film methods, such as electrolytic plating and electroless deposition, further is illustrated if needed.

[0056]However, in this embodiment, as shown in drawing 6 (A) and (B), First, after forming in the surface of the base 20 the plating resist layer 60 which has the opening 62 of desired pattern shape, the method of forming the metal membrane 22 by the wet forming-membranes methods, such as electrolytic plating and electroless deposition, is adopted as this opening 62.

[0057]Although the thickness D1 (refer to drawing 5) of the metal membrane 22 to form can be suitably set up according to a use, as an object for the internal electrodes of the laminated ceramic capacitor with which lamination is demanded, for example, what is necessary is just about 0.1-1.5 micrometers.

[0058]Although there is no restriction about the presentation of the metal membrane 22, as an object for the internal electrodes of a laminated ceramic electronic component, When what is necessary is just to consider it as metal, such as Ag, Cu, Pd, and nickel, or these alloys and a metal membrane is formed especially by electrolytic plating and electroless deposition,

elements, such as P, B, S, and C, may be included.

[0059]The metal membrane 22 may comprise a metal membrane in which it may comprise a single layer or two or more presentations differ.

[0060]As an electroless deposition bath at the time of forming the metal membrane 22, For example, the bath of the nickel phosphorus type which used sodium phosphinate as the reducing agent in the case of the nickel alloy film, Although what is necessary is just to use the bath etc. of the nickel boron type which used hydrogenation boron sodium, dimethylamine borane, etc. as the reducing agent, in using as an electrode of a laminated ceramic electronic component, It is desirable for the amounts of eutectoids, such as P and B, to choose few baths in consideration of a reaction with the ceramics at the time of sintering.

[0061]As an electrolytic plating bath at the time of forming the metal membrane 22, when forming a nickel metal film, for example, the sulfamate bath which uses as the main ingredients what is called a Watts bath that uses nickel sulfate, nickel chloride, and way acid as the main ingredients, nickel amiosulfonate, nickel bromide, and way acid is used. When forming a copper metal film, plating baths currently used widely, such as what is called a Pirro copper bath that uses copper pyrophosphate and potassium pyrophosphate as the main ingredients, can be used. Additive agents, such as a stress adjustment agent, a surface-active agent, or a leveling agent, may be included in the plating bath in addition to the above-mentioned main ingredients.

[0062]Subsequently, as shown in drawing 6 (C), the 1st glue line 24 is laminated on the surface of the metal membrane 22 formed on the base 20.

[0063]Although the formation method in particular of the 1st glue line 24 is not limited, it is formed with electropainting by this embodiment.

[0064]About the presentation of the 1st glue line 24, it constitutes from this embodiment including the thermoplastic organic high polymer.

[0065]The base 20 is immersed into an organic high polymer emulsion or a solution, and formation of the 1st glue line 24 that comprises the thermoplastic organic high polymer by electropainting is performed by using the metal membrane 22 as the negative pole or the anode, and carrying out electrolytic treatment, after forming the metal membrane 22 patternized [above-mentioned].

[0066]As an organic high polymer emulsion or a solution, although an epoxy system, acrylic, a vinyl acetate system, an acrylic copolymerization system, etc. are available, When the pyrolysis nature at the time of calcinating a ceramic layered product is also taken into consideration, it is desirable to choose what can deposit by anode electrolysis or negative pole electrolysis from acrylic or an acrylic copolymerization system.

[0067]The thickness D2 (refer to drawing 5) of the 1st glue line 24 should just have the thickness of the grade which can be pasted up on the porous intermediate medium mentioned

later, and the range of it is 0.1-10 micrometers preferably. The thickness D2 is controllable by setting electrodeposited voltage as a predetermined value. In electropainting, it is a stage where the insulator layer of thickness according to impressed electromotive force was formed on the surface of metal, and is because growth of an insulator layer stops.

[0068]In said organic high polymer emulsion or a solution. While being able to add organicity / inorganic paints, etc. if needed as well as the usual electropainting and coloring of the 1st glue line 24 being possible, it is also possible to give effects, such as an adhesion improvement with the ceramic layer and metal membrane in a laminated ceramic electronic component and antioxidizing of a metal membrane.

[0069]Subsequently, it exfoliates with the release liquid which chose the formed regist layer 60 on the base 20 so that the 1st glue line 24 might not be dissolved, such as an organic solvent, acid, and alkali. As a result, as shown in drawing 6 (D), the metal membrane 22 is formed in the surface of the sheet-shaped base 20 with a prescribed pattern so that it can exfoliate, and the member 30 for metal membrane transfer by which the 1st glue line 24 was laminated by the surface of the metal membrane 22 is obtained. When the regist layer 60 is comparatively thin, it is in the state which left the regist layer 60, and it is also possible to perform transfer to the porous intermediate medium mentioned later.

[0070]subsequently -- making the obtained member 30 for metal membrane transfer laminate so that the 1st glue line 24 may contact the surface of the porous intermediate medium 40 as shown in drawing 6 (E) -- both -- desirable -- the temperature of 20 - 40 degreeC** -- and it pressurizes by the pressure of 5 - 100 kg/cm² preferably.

[0071]As a result, the metal membrane 22 of a prescribed pattern is pasted up on the porous-intermediate-medium 40 side good by operation of the 1st glue line 24.

[0072]Subsequently, the surface of the porous intermediate medium 40 is made to transfer the metal membrane 22 via the 1st glue line 24 by removing the base 20 from the porous-intermediate-medium 40 side, as shown in drawing 6 (F).

[0073]As the porous intermediate medium 40, the filter paper is used by the embodiment shown in drawing 6. The thickness in particular of the porous intermediate medium 40 is not limited, for example, is suitably determined in 0.05-0.2 mm.

[0074]On subsequently, the surface of the porous intermediate medium 40 for which the metal membrane 22 of the prescribed pattern was transferred via the 1st glue line 24 in this embodiment as shown in drawing 6 (G) and (H). It applies to the whole surface, and after spreading, it is the temperature of 20-80 degreeC preferably, and the 2nd glue line formation solution 26 is preferably dried for 5 to 10 minutes. By carrying out like this, as shown in drawing 6 (I), the 2nd glue line formation solution 26 on the porous intermediate medium 40 with which the metal membrane 22 is not formed is diffused in the porous intermediate medium 40, and can form the 2nd glue line 26a only in the surface of the metal membrane 22.

[0075]The 2nd glue line formation solution 26 which forms the 2nd glue line 26a comprises the emulsion or solution containing the organic binder chosen so that it might not dissolve in the drug solution for transfer mentioned later. as such an organic binder -- alcohol -- an insoluble acrylic resin etc. are illustrated. In a solution, various additive agents, such as organicity / inorganic paints, can also be added if needed.

[0076]Spreading in this embodiment is not limited to coating in a narrow sense, but is used in a meaning also including sprinkling spraying the solution or being immersed in the organ bath filled with the solution. The formation method in particular of the 2nd glue line 26a is not limited, but may be formed with electropainting mentioned above.

[0077]Although the thickness D3 of the 2nd glue line 26a is metal membrane thickness and the thinness below equivalent and their uniform thing is desirable, in order to use such thickness, it is desirable to choose what has sufficiently small particle diameter or molecular weight of an emulsion.

[0078]Subsequently, the 2nd glue line 26a of the porous intermediate medium 40 makes it laminate so that the surface of the green sheet 10a shown in drawing 3 may be contacted as shown in drawing 6 (J). Under the present circumstances, some may be pressurized at ordinary temperature.

[0079]Subsequently, as shown in drawing 6 (K), the drug solution 50 which can dissolve the resin which constitutes the 1st glue line 24 from the back of the porous intermediate medium 40 is supplied. As a result, the drug solution 50 dissolves and absorption diffusion of the resin which constitutes the 1st glue line 24 is carried out into a porous intermediate medium. Then, by removing the porous intermediate medium 40 from the green sheet 10a side, the metal membrane 22 is transferred by the surface of the green sheet 10a good via the 2nd glue line 26a, and the pattern 12a (refer to drawing 3) of a metal membrane is obtained. The pattern 14a (refer to drawing 3) of other metal membranes can be similarly formed with a replica method.

[0080]The feeding method of the drug solution 50 to the porous intermediate medium 40, Even if it is not limited but supplies from the 1st glue line 24 side of the porous intermediate medium 40 especially, it is good also as supplying from the field in which the 1st glue line 24 is not formed, i.e., the back of the porous intermediate medium 40, and the whole porous intermediate medium 40 being further immersed in the drug solution 50.

[0081]The drug solution 50 for the dissolution used in this invention is suitably determined by a relation with the resin which constitutes said 1st glue line 24.

[0082]The green sheet 10a formed by the patterns 12a and 14a which the metal membrane 22 shows to drawing 3 with such a replica method, Two or more sheets are laminated with the green sheet 10a in which the pattern is not formed at all if needed, and the green chip before calcination is obtained by cutting along the cutout line 16.

[0083]Next, debinding processing and baking treatment are performed to this green chip. Although what is necessary is to perform debinding processing before calcination and just to carry out on condition of usual, in using base metals, such as nickel and a nickel alloy, especially as a conducting material of an internal electrode layer, In an air atmosphere, a heating rate is carried out in 10-100 °C/h, and 5-300 °C/hour of 200-300 °C and temperature retention time are more preferably made into 5 to 20 hours for retention temperature an hour for 0.5 to 24 hours. [180-400 °C of]

[0084]As for the firing environments of a green chip, although what is necessary is just to determine it suitably according to the kind of metal membrane, when using base metals, such as nickel and a nickel alloy, as a conducting material, it is preferred to make the oxygen tension of a firing environments into 1×10^{-8} - 1×10^{-12} atmospheric pressure. If oxygen tension is too low, the conducting material of an internal electrode will cause unusual sintering, and will break off, and when oxygen tension is too high, it is in the tendency for an internal electrode to oxidize. 1100-1400 °C of retention temperature at the time of calcination is 1200-1380 °C more preferably. It is in the tendency for elaborating to become insufficient if this retention temperature is too low, for the electrode by unusual sintering of an internal electrode to break off if retention temperature is too high, or for capacity temperature characteristics to get worse by diffusion of the quality of an internal electrode material.

[0085]As firing conditions other than this, more preferably a heating rate an hour 50-500 °C/200-300 °C/hour. More preferably a cooling rate for temperature retention time for 1 to 3 hours for 0.5 to 8 hours 50-500 °C/hour. It is more preferably considered as an hour in 200-300 °C/h, as for a firing environments, it is desirable to consider it as a reducing atmosphere, and it is desirable to humidify and use the mixed gas of nitrogen gas and hydrogen gas as a controlled atmosphere, for example.

[0086]When it calcinates by a reducing atmosphere, it is desirable to give annealing to the sintered compact of a capacitor chip. In the debinding processing, the calcination, and the annealing process which were mentioned above, in order to humidify nitrogen gas and mixed gas, Wetter etc. can be used, for example. As for the water temperature in this case, it is desirable to consider it as 5-75 °C.

[0087]The capacitor element pack 4 shown in drawing 1 and drawing 2 as mentioned above is obtained. If the terminal electrodes 6 and 8 are formed in the both ends of this obtained capacitor element pack 4, the laminated ceramic capacitor 2 will be obtained.

[0088]While being able to manufacture the laminated ceramic capacitor in which thickness has an internal electrode which is thinly uniform and has few defects by very easy and low cost according to the manufacturing method of the laminated ceramic capacitor concerning this embodiment, automation of a production line can be made easy.

[0089]As for this invention, although the embodiment of this invention has been described

above, it is needless to say that it can carry out in the mode which becomes various within limits which are not limited to such an embodiment at all and deviate from the gist of this invention.

[0090]For example, in this invention, the member for metal membrane transfer is produced using a long base. It piles up with the porous intermediate medium similarly produced by the long picture, and in a carrying process, nip may be carried out with a pressure roll, the 1st transfer process may be performed, and the 2nd transfer process from a porous intermediate medium to a ceramic green sheet may be continuously performed in a carrying process after that. In this case, the productivity of a laminated ceramic electronic component can be improved further.

[0091]After making the porous intermediate medium 40 laminate in the embodiment mentioned above so that the 2nd glue line 26a may contact the surface of the green sheet 10a, Although the drug solution 50 which can dissolve the resin which constitutes said 1st glue line 24 in the porous intermediate medium 40 is supplied and the metal membrane 22 is transferred to the green sheet 10a, it is not limited to this. For example, after contacting the porous intermediate medium 40 to the drug solution 50 which can dissolve the 1st glue line 24 and dissolving said 1st glue line 24, It is good also as laminating the metal membrane 22 side of said porous intermediate medium 40 on the surface of the green sheet 10a, pulling apart said porous intermediate medium 40 from the surface of said green sheet 10a after that, and transferring the metal membrane 22 on the surface of the green sheet 10a. However, after dissolving the 1st glue line 24, by the time it makes the surface of the green sheet 10a laminate in that case, It is preferred to laminate on the surface of the green sheet 10a, and to transfer the metal membrane 22, holding the metal membrane 22 on the surface of the porous intermediate medium 40 by the holding mechanism of a vacuum sucking device etc. so that the metal membrane 22 may not shift from the surface of the porous intermediate medium 40.

[0092]

[Example]Hereafter, although this invention is explained based on a still more detailed example, this invention is not limited to these examples.

[0093]Example 1 one side was insulated extensively and the stainless plate which left the opening of the pattern shape of a request of other sides, and printed the plating resist of toluene fusibility was prepared as a base.

[0094]As pretreatment to a base, after performing alkali electrolytic degreasing and chloride pickling, it was immersed in the exfoliation treating solution (knickerbockers non made from Nihon Kagaku Sangyo tuck) for 1 minute, and *****-ized processing was performed.

[0095]Subsequently, 300 g/L of nickel amiosulfonate, 5 g/L of nickel bromide, It was immersed in the sulfamic acid nickel plate bath which consists of 30 g/L of way acid, and 0.5 g/L of naphthalene disulfon acid sodium as a stress reducer, plating treatment was performed for 6

minutes in the temperature of 50 **, pH 4.5, and cathode-current-density 0.5 A/dm², and the nickel layer was deposited.

[0096]When asked for the thickness of the nickel layer by the fluorescence-X-rays thickness gage, it was 0.5 micrometer on the average.

[0097]Nonvolatile matter concentration by using as the anode the stainless plate nickel layer formed [above] 3 % of the weight, the acrylic ester emulsion (the product made from Japanese NSC.) which prepared pH to 7.0 YODOZORUAD93, the diameter of an emulsion = it was immersed during 0.1 micrometer, glass transition point = -10 **, and an anion type, and the 1st glue line that performs electrodeposited processing for 60 seconds on the voltage of 10V, and consists of acrylic ester resin was formed.

[0098]When the appearance of a glue line is transparent, is assuming the interference color extensively and calculated the thickness from the amount of weight increments, it was 0.6 micrometer.

[0099]Toluene washed the stainless plate with which the aforementioned nickel layer and the 1st glue line were formed, and dissolution removal of the plating resist for patterning was carried out. Under the present circumstances, it did not dissolve but the 1st electrodeposited glue line remained on the nickel layer.

[0100]In this way, immediately after piling up the filter paper (the object for fixed quantity, No.5C) and pressurizing by the pressure of 20 kg/cm² in ordinary temperature on the obtained nickel layer which was patternized in which the 1st glue line was formed, the base film by the side of a nickel layer was removed. On the filter paper, the nickel layer was transferred good without inferior transfer.

[0101]Subsequently, the nickel layer side of the filter paper through which the obtained nickel layer was formed is piled up on a green sheet with a thickness of 4 micrometers which consists of the acrylic organic binder, barium titanate, and additive agents, such as a plasticizer, which were formed on the base film made from polyethylene terephthalate. The light load of 5 g/cm² was added using the metallic net of 0.3 mm of openings, and it was made to stick so that a crevice may not be made. After it sprayed the ethanol which can dissolve said 1st glue line (or dropping) and the ethanol concerned dried in the state, the metallic net was removed and the filter paper was pulled apart from the surface of the green sheet.

[0102]When the surface of the obtained green sheet was observed by viewing, the nickel layer was transferring without the defect and destruction of the green sheet was not accepted, either. After that, when the nickel layer side was rubbed several times, the nickel layer exfoliated a little.

[0103]The filter paper through which the nickel layer was transferred on the filter paper transferred [nickel layer] was produced like example 2 Example 1. This filter paper transferred

[nickel layer] was immersed into the 0.5% toluene solution of the acrylic resin (the product made from E. I. du Pont de Nemours , Elvacite 2046) of alcoholic insolubility, it liquid-cut, and it dried and the 2nd 0.1-micrometer-thick glue line was formed on the surface of the nickel layer.

[0104]Subsequently, the nickel layer was transferred for said 2nd glue line side of the filter paper through which the 2nd glue line was formed transferred [nickel layer] in piles on the green sheet like Example 1.

[0105]When the surface of the obtained green sheet was observed by viewing, the nickel layer was transferring without the defect and destruction of the green sheet was not accepted, either. Like Example 1, although the nickel layer side was rubbed several times, the nickel layer did not exfoliate. Even if vacuum absorption of the obtained green sheet was carried out and it conveyed it, peeling of a nickel layer was not produced.

[0106]Instead of example 3 filter paper, the nonwoven fabric in which the nickel layer was transferred on the nonwoven fabric transferred [nickel layer] was produced like Example 1 except having used the nonwoven fabric made from polyethylene terephthalate. The 2nd glue line was formed in the surface of the nickel layer of this nonwoven fabric transferred [nickel layer] by the same method as Example 2.

[0107]Subsequently, said 2nd glue line side of the nonwoven fabric in which the 2nd glue line was formed transferred [nickel layer], Like Example 1, it piled up on the green sheet, and after it carried out the spray of the ammonium carbonate solution 1% and the liquid concerned dried all over the nonwoven fabric transferred [nickel layer] after that, the nonwoven fabric was pulled apart from the surface of the green sheet.

[0108]When the surface of the obtained green sheet was observed by viewing, the nickel layer was transferring without the defect and destruction of the green sheet was not accepted, either. Like Example 2, although the nickel layer side was rubbed several times, the nickel layer did not exfoliate, and even if vacuum absorption of the green sheet obtained further was carried out and it conveyed it, peeling was not produced to metal.

[0109]The filter paper through which the nickel layer was transferred on the filter paper transferred [nickel layer] was produced like example 4 Example 2. The 2nd glue line was formed in the surface of the nickel layer of this filter paper transferred [nickel layer] like Example 2.

[0110]With the 2nd glue line of the obtained filter paper transferred [nickel layer], having drawn in using the vacuum pump and preventing movement by omission of a nickel layer from an opposite side, ethanol was made to permeate a filter paper, only the 1st glue line by electrodeposition was dissolved in it, and adhesive strength was lost. After ethanol dried, the green sheet was piled up, and after applying the pressure of 50 g/cm^2 using a rubber elastomer, the filter paper was pulled apart from the surface of the green sheet.

[0111]When the surface of the obtained green sheet was observed by viewing, the nickel layer

was transferring without the defect and destruction of the green sheet was not accepted, either. Although the nickel layer peripheral part on the surface of a green sheet was observed using the microscope, the defect was not accepted in a green sheet.

[0112]The stainless plate with which the nickel layer and the 1st glue line of the prescribed pattern were formed was produced like comparative example 1 Example 1.

[0113]The nickel layer side of this stainless plate was made to counter the surface of a green sheet with a same thickness [the / as Example 1] of 4 micrometers, and was piled up, it pressurized by the pressure of 5 kg/cm^2 in ordinary temperature, and the nickel layer was transferred.

[0114]Although the nickel layer was transferred thoroughly, when the green sheet was observed under the microscope, the place currently destroyed was checked in accordance with the circumference of a nickel layer pattern.

[0115]

[Effect of the Invention]As explained above, according to this invention, the pattern of a very thin and uniform metal membrane can be transferred very easily and certainly on the surface of a transferred member on which a green sheet etc. break easily, and the transfer method of a metal membrane suitable for especially automation of a transfer line can be provided.

[0116]According to this invention, very easy and the manufacturing method of the laminated ceramic electronic component which could manufacture by low cost and fitted especially automation of the production line can be provided for the laminated ceramic electronic component in which thickness has an internal electrode which is thinly uniform and has few defects.

[Translation done.]